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STUDENT GUIDE

Motorized Grader

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PREFACE

The purpose of this handout is to provide information on the capabilities, characteristics, components, attachments, controls and instruments, hand and arm signals, safety, operator's preventive maintenance checks and services and operating procedures on the Motorized Grader. If you look at the table of contents and follow through the student guide, you will find it is sequentially constructed in the order you will receive training.

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Chapter 1

Introduction to the Motorized Grader

1. Motor graders taught at the motor grader operator's course are:

    1) Caterpillar, Model 130G

    2) Champion, 700 Series

    3) John Deere, 670 Series

NOTE: All graders are similar with minor differences, so no matter what type, the principles of operation and basic controls will vary little.

2. Characteristics

    a. Diesel engine driven (DED)

    b. Rubber tired

    c. Articulated frame

    d. Tandem chain driven

3. Capabilities

    a. Graders are ideal for finishing grade on construction projects.

    b. Utilized for precise final shaping. When doing precise and final grading, use lowest gear possible.

    c. Perform light stripping.

    d. Used to level minor ground irregularities.

    e. Perform road and runway maintenance.

    f. Mix and spread materials.

    g. Light scarifying.

    h. Utilized to slope banks. For slopes greater then 3:1, you must use the high bank slope position.

    i. Will cut V-ditches and flat bottom ditches up to three feet deep.

    j. Snow removal

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4. Limitations

   a. The grader is restricted to working on slopes no greater than 3:1.

   b. In muddy conditions the grader looses traction, which causes decreased grader efficiency.

   c. The grader is also restricted to making shallow cuts in medium-hard material; it should not be used for heavy excavation.

5. Major Components of the grader are:

   a. Diesel engine driven, oil lubricated, water cooled, turbo charged, fuel injected engine (4 or 6 cylinders depending on the grader); started by an electric motor.

   b. Oil lubricated - lubrication reduces friction between moving parts. Friction is harmful because it wears out parts and generates heat. Lubrication is not confined to the use of grease. If the graders engine is not filled to the proper oil level it isn't going to last very long.

      1) Proper level checked by a dipstick

      2) Cold check

      3) Hot check

      4) Level must be between the add and full marks.

      5) Refer to the operator's manual for proper type of oil to be utilized.

   c. Allow the engine to warm up and cool down for 3 to 5 minutes to prevent damage to the turbo-charger.

   d. Water cooled - equipped with a large capacity radiator. Check the coolant by removing the radiator cap. If the coolant is not visible in the filler tube, add coolant.

   e. Fuel System - equipped with a large capacity fuel tank. Check the fuel by the procedures listed in the TM of that certain piece of equipment.

      1) Fuel filters - equipped with two different fuel filters to insure that the fuel is clean prior to entering the engine. If they are properly cared for, these could prevent damage to the engine.

         a) Primary fuel filter - filter that the fuel passes through to catch most of the debris out of the fuel.

         b) Secondary fuel filter - a back up filter used to catch what the primary filter misses.

      2) Fuel primer - used to prime the engine in the event the operator runs the grader out of fuel.

   f. Air induction system - a two stage system.

      1) Pre-cleaner - stops large objects such as leaves and rocks from entering the engine.

      2) Main filter assembly - traps smaller objects from entering the engine.

      3) Primary filter element (outer).

      4) Secondary filter element (inner).

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5) Air filter indicator

g. Transmission

1) Refer to the operator's manual for proper oil type to be utilized.

2) Hydraulically powered.

3) Power shift with multiple speed settings.

4) Clutch / Inching Pedal / Modulator

5) Utilized to place the grader in motion.

6) Utilized to stop the grader in conjunction with the brake.

h. Tandems

1) Two sets of two wheels, one in front of the other to provide traction and power.

2) Oil lubricated (proper level checked by a dipstick):a) Cold check

3) Level must be kept between the add and full marks.

Refer to the operator's manual for proper oil type to be utilized.

4) Chain driven

5) Single tandem drive for road travel.

6) Dual tandem drive for grading:

7) Manual differential lock for the Caterpillar, John Deere and the new Champion graders.

8) Limited slip differential on the older Champion graders.

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i. Wheels and Tires:

1) Four drive wheels with two steering wheels (6x4).

2) Self-cleaning tire treads.

3) Rear tire tread - the point of the "V" meets the ground first for traction.

4) Front tire tread - is reversed to prolong the tire life.

5) Maintain the tire pressure at 35 PSI.

WARNING: Improperly inflated tires can cause blowouts resulting in personal injury or death.

Transition: Understanding some of the capabilities of the motor grader will assist you in determining how to start the project. With this understanding, a basic knowledge of the attachments that are available on the grader will make your decision easier.

6. Related components

a. Moldboard: The moldboard with the cutting edges and end bits attached is called the blade. The moldboard is the working tool of the grader that can be lifted, lowered, rotated, pitched forward or backwards, shifted to the left or right, and can be angled horizontally.

1) Leading point of the blade is referred to as the "TOE".

2) Trailing point of the blade is referred to as the "HEEL".

3) Approximate length is 12 feet.

4) The moldboard consists of:

5) Two cutting edges - acts as wear plates.

6) Two end bits - acts as wear plates.

7) Bolts, nuts, and washers - holds the cutting edges and end bits to the moldboard.

8) The recommended replacement point is when the cutting edge or end bits are worn within 3/4" of the moldboard.

b. Circle: Located at the center of the grader, it's a table top apparatus that the moldboard is attached to. The circle provides clockwise and counter-clockwise rotation of the moldboard.

c. Hydraulic cylinders

1) Lift cylinders: These lift cylinders are attached to the top of the circle (one on the right and one on the left) that allows you to raise and lower the moldboard.

2) Center shift cylinder: This cylinder is located on top of the circle that allows the operator to shift the circle assembly and moldboard to the left or right. It’s primarily used to align (straighten) the lift (heel) cylinders.

3) Blade pitch cylinder: A single cylinder attached to the back of the moldboard and connected to the circle. Allows the operator to adjust the pitch of the blade in one of the three basic positions:

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a) Pitched all the way forward - for greater mixing and rolling action of the material.

b) Pitched all the way backwards - for greater mixing action and greater cutting action.

c) Pitched halfway - used for spreading, finishing, and leveling surface material. This is also called the general cutting position and it will extend the use of the cutting edges.

NOTE: The general grade position will extend the use of the cutting edge.

4) Blade side shift cylinder: A single cylinder positioned parallel and attached to the back of the moldboard that allows the operator the ability to extend the moldboard left or right providing a greater versatility in earth moving procedures. It is primarily used in the wide side reach position.

d. Scarifier log: A hydraulically controlled unit with a set of teeth that is used to break up material too compacted to be penetrated by the blade. Scarifier logs are not the same on all graders. The location and number of teeth on the Scarifier log will vary.

1) Up and down movement hydraulically controlled.

2) Maximum number of teeth is used for moderate to hard soil.

3) Minimum number of teeth is used for hard to very hard soil.

4) A component of the scarifier log is the tooth; which consists of:

5) Shank

6) Cap

7) The tooth is held into place (on the log) by a lock pin.

8) Replace the cap when it is 3/4" from the shank (measured from the back).

9) When removing the teeth from the scarifier log, remove every other one. The key is to ensure the same amount of teeth is on both sides of the scarifier log.

CAUTION: NEVER MAKE SHARP TURNS WITH THE SCARIFIER IN THE GROUND. DOING SHARP TURNS DAMAGES THE SCARIFIER AND CAN POSSIBLY BEND OR BREAK THE TEETH.

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e. Wheel lean

1) Used to minimize side drafting while grading.

2) Also used to assist in steering.

3) One cylinder located inside of right front wheel and above the axle.

4) Never used in conjunction while backing.

NOTE: Wheels must remain straight up and down while in the backing mode.

f. Articulation: Some graders have frames that are hinged just forward of the engine compartment with articulation controlled by a pair of hydraulic cylinders. The articulation frame has a shorter turning radius than the conventional grader.

1) These two cylinders work in unison, one extends as the other retracts to aid in steering.

2) Allows for an increase in productivity and stability. With the increased turning ability, it permits easier maneuvering in close quarters.

3) There are three modes of steering:

a) Straight frame - used for long distance type grading (articulation is set to 0).

b) Crab mode - primarily used to clean out wet ditches.

c) Articulation mode - used in tight working conditions.

Transition: By now you're starting to see the big picture. At this time let's fill in some of the details and explain how to control or rather manipulate the components. We'll start of by discussing the controls of the Caterpillar, then go over the Champion, and then finish up with the John Deere.

Caterpillar Earthmoving Controls:

1. Left lift cylinder lever:

a. Push forward - the left side of the moldboard will lower.

b. Pull backwards - the left side of the moldboard will rise.

2. Blade side shift lever:

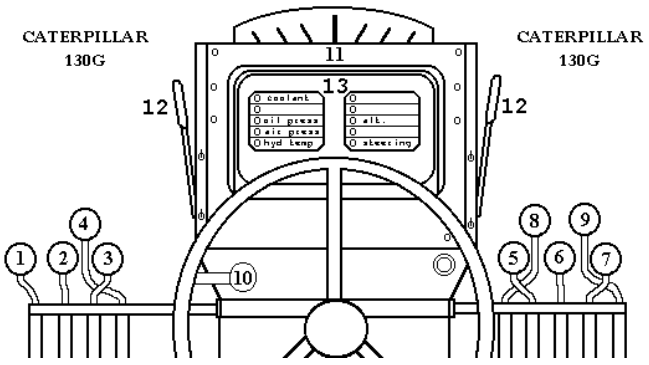
a. Push forward - the blade shifts to the left.

b. Pull backwards - the blade shifts to the right.

3. Circle control turn lever:

a. Push forward - the moldboard rotates counter-clockwise.

b. Pull backwards - the moldboard rotates clockwise.



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4. Blade pitch lever:
    a. Push forward - the blade will pitch forward.
    b. Pull backwards - the blade will pitch backwards.

CAUTION: To prevent tire damage, do not allow the blade to contact the tires when rotating the circle.

5. Center shift lever:
    a. Push forward - the circle and moldboard will move to the left.
    b. Pull backwards - the circle and moldboard will move to the right.
6. Wheel lean lever:
    a. Push forward - the wheels lean to the left.
    b. Pull backwards - the wheels lean to the right.
7. Right lift cylinder lever:
    a. Push forward - the right side of the moldboard will lower.
    b. Pull backwards - the right side of the moldboard will rise.
8. Articulation control lever:
    a. Push forward - the rear of the grader articulates to the left.
    b. Pull backwards - the rear of the grader articulates to the right.

NOTE: The articulation indicator located above the EMS panel on the steering console, shows how far the grader has articulated to the left or right

CAUTION: When articulating, do not allow the blade to contact the tires.

9. Scarifier control lever:
    a. Push forward - the scarifier will lower.
    b. Pull backwards - the scarifier will rise.
10. Turn signal control lever - used to notify other operators that you are turning.
11. Electronic Monitoring System (EMS) panel - used to monitor the status of your grader. It shows the following items:
    a. Coolant temp
    b. Engine oil pressure
    c. Brake air pressure

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d. Hydraulic oil temperature

e. Alternator

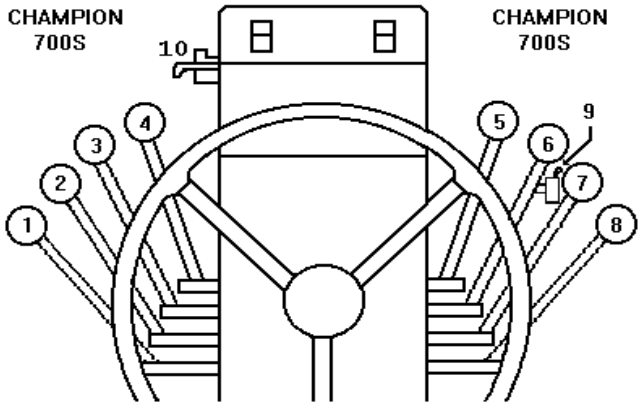
f. Steering

12) Steering console lock levers - used to adjust steering console towards or away from the operator.

13) Articulation indicator - used to verify articulation angle of the grader.

Note: At this point we will discuss the location of the various controls of the Champion and John Deere graders, but not go into any details of how they function. Since all hydraulic controls function the same way, it's key to note that when pushing a control lever forward the apparatus will either lower or move to the left. Thus, a reverse effect by pulling a control lever backward; the apparatus will either raise of move to the right.

Champion 700 Series Earthmoving Controls:



1. Blade pitch lever:

   a. Push forward - the blade will pitch forward.

   b. Pull backwards - the blade will pitch backwards.

CAUTION: To prevent tire damage, do not allow the blade to contact the tires when rotating the circle.

2. Left lift cylinder lever:

   a. Push forward - the left side of the moldboard will lower.

   b. Pull backwards - the left side of the moldboard will rise.

3. Blade side shift lever:

   a. Push forward - the blade shifts to the left.

   b. Pull backwards - the blade shifts to the right.

4. Circle control turn lever:

   a. Push forward - the moldboard rotates counter-clockwise.

   b. Pull backwards - the moldboard rotates clockwise.

5. Center shift lever:

   a. Push forward - the circle and moldboard will move to the left.

   b. Pull backwards - the circle and moldboard will move to the right.

6. Wheel lean lever:

   a. Push forward - the wheels lean to the left.

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b. Pull backwards - the wheels lean to the right.

7. Right lift cylinder lever:

   a. Push forward - the right side of the moldboard will lower.

   b. Pull backwards - the right side of the moldboard will rise.

8. Scarifier control lever:

   a. Push forward - the scarifier will lower.

   b. Pull backwards - the scarifier will rise.

9. Articulation control switch:

   a. Push switch left - the rear of the grader articulates to the left.

   b. Pull switch right - the rear of the grader articulates to the right.

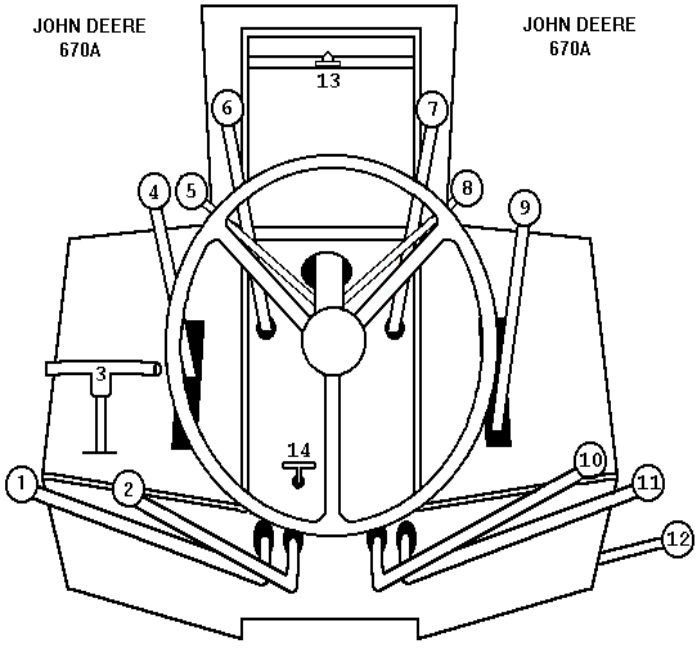
   c. Leave the switch centered - locks the articulation into the desired position.

NOTE: The articulation indicator located left hand side of cab; mounted on the ROPS, shows how far the grader is articulated to the left, right, and or centered.

CAUTION: When articulating, do not allow the blade to contact the tires.

10. Turn signal control lever - used to notify other operators that you are turning.

John Deere 670 Series Earthmoving Controls:



1. Scarifier control lever:

   a. Push forward - the scarifier will lower.

   b. Pull backwards - the scarifier will rise.

   c. All the way forward - detent position, puts the scarifier in the float position.

2. Blade pitch lever:

   a. Push forward - the blade will pitch forward.

   b. Pull backwards - the blade will pitch backwards.

3. Blade side shift and Circle control lever:

   a. Push Left - the blade shifts to the left.

   b. Pull right - the blade shifts to the right.

   c. Twist left - the moldboard rotates counter-clockwise.

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d. Twist right - the moldboard rotates clockwise.

CAUTION: To prevent tire damage, do not allow the blade to contact the tires when rotating the circle.

4. Direction control lever:

   a. Push forward - the grader goes forward.

   b. Pull backwards - the grader goes in reverse.

   NOTE: Levers 5 & 8 are the same lever connected to the steering column by a collar.

5. Articulation control levers:

   a. Pull lever 5 down - the rear of the grader articulates to the left.

   b. Pull lever 8 down - the rear of the grader articulates to the right.

NOTE: The articulation indicator located on top of the control panel, shows how far the grader has articulated to the left or right or when it is centered.

CAUTION: When articulating, do not allow the blade to contact the tires.

6. Center shift lever:

   a. Push left - the circle and moldboard will move to the left.

   b. Push right - the circle and moldboard will move to the right.

7. Wheel lean lever:

   a. Push left - the wheels lean to the left.

   b. Push right - the wheels lean to the right.

8. Gear selection lever:

   a. Push forward - the gear selection lowers.

   b. Pull backwards - the gear selection rises.

9. Left lift cylinder lever:

   a. Push forward - the left side of the moldboard will lower.

   b. Pull backwards - the left side of the moldboard will rise.

10. Right lift cylinder lever:

    a. Push forward - the right side of the moldboard will lower.

    b. Pull backwards - the right side of the moldboard will rise.

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Note: By placing both lift cylinder control levers all the way forward into the detent position, puts the moldboard into the float position.

11. Hand throttle control lever:

    a. Push forward - accelerates the engine to operating range.

    b. Pull backwards - decelerates the engine.

    c) Push to the right and backwards - shuts off the fuel to the engine for proper engine shut down.

12. Articulation indicator - use to verify articulation angle of the grader.

13. Parking brake release - pull up to release the parking brake.

Transition: We've just about wrapped up the basic functions of the graders, so let's discuss a few items that will benefit you as the student.

1. General rules of operation:

    a. Always engage the park brake when parking the grader. Also, ensure the park brake is disengaged prior to placing the transmission in gear.

    b. Grade in first gear only (for training purposes and safety).

    c. All grading and scarifying will be accomplished in a forward motion.

    d. Always set the hand throttle to full (maximum) RPMs to conduct any scarifying or earth moving operation.

    e. Never back the grader with the hand throttle engaged. Always reduce the hand throttle to idle and use the foot throttle control pedal during backing operations.

    f. The foot throttle control pedal will be used during positioning maneuvers or travel operations.

    g. In the event the grader must be stopped during earth moving or scarifying operations, use the deceleration pedal to temporarily reduce the RPMs.

    h. Graders equipped with a manual differential lock and unlock should be placed in the locked position upon entering the field of operation or when engaged in any earth moving operation. Be certain to unlock the differential when traveling to and from the field to prevent damage to the tandems.

    i. Graders equipped with the limited slip differential will automatically engage and disengage as traction is reduced or gained.

NOTE: When working on construction sites, do not over strip the area. Damage is also caused by erosion due to rain. This erosion damage can be minimized by dressing off the work area at the end of each day. After you have completed the project, restore the area as close as possible to its original state.

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Chapter 2

Hand and Arm Signals

1. Coordinated blade end movement – Left arm raised with thumb up, right arm down with thumb down.
2. Lower end of blade – Arm raised with thumb down and opposite arm to side.
3. Raise end of blade – Arm raised with thumb up and opposite arm to side.
4. Circle blade left – Using left arm, make a circular motion indicating direction to circle blade.
5. Circle blade right – Using right arm, make a circular motion indicating direction to circle blade.
6. Slide blade left – Arm is bent across the front of the body pointing the direction of slide.
7. Slide blade right – Arm is bent across the front of the body pointing the direction of slide.
8. Scarifier up – Arm raised with fingers extended and spread.
9. Scarifier down – Arm lowered with fingers extended and spread.
10. Center shift left – Arms form a circle in front of the body with fists together and offset from body in direction of shift.
11. Center shift right – Arms form a circle in front of the body with fists together and offset from body in direction of shift.
12. Wheel lean left – Arms extended and angled left, fingers joined.
13. Wheel lean right – Arms extended and angled right, fingers joined.
14. Wheel lean straight – Arms extended straight up, fingers joined.
15. Carry position – Arms across the body with hands cupped.
16. Park line position – Arms extended out to both sides with fingers joined.
17. Pitch blade down – Arms extended, fingers joined out to your side.
18. Pitch blade up – Elbows bent and hands pulled into chest.
19. Straighten heel cylinder – Arm bent at the elbow facing up, opposite arm is placed on the bent forearm moving up and down.

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Chapter 3

Safety

1. Safety Requirements:

   a. Personal Protective Equipment

      1) Gloves

      2) Goggles

      3) Safety boots

      4) Hard hat/Kevlar

      5) Hearing protection

   b. Perform a 360° walk around before mounting and after dismounting the grader.

   c. Maintain three points of contact when mounting or dismounting.

   d. Ground all attachments and engage the parking brake before dismounting.

   e. Adjust the mirrors after each change of operators, and use the mirrors when backing.

   f. Seat belts will be worn.

   g. Go slow under dusty conditions.

   h. Know and adhere to all hand signals

   i. Do not adjust the defroster fans while they are running.

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Chapter 4

Operators Preventive Maintenance Checks and Services

NOTE: Thirty minutes will be used at the beginning of each day for before operators maintenance and 30 minutes will be used at the end of each day for after operator's maintenance.

1. The items to be inspected are found in the following technical manuals.

    a. Caterpillar, Model 130G, TM 5-3805-261-10.

    b. Champion, 700 Series Operator's Manual.

    c. John Deere, Model JD-670 Operator's Manual.

2. Locate the pre-operation checklist in the technical manual or the operator's manual for the specific model of grader the student is performing maintenance on.

NOTE: Listed below are additional checks for the John Deere.

    a. Overall structural damage

    b. Cracked and or leaking hydraulic lines or fittings

    c. All hydraulic lines

    d. Radiator reservoir

    e. Tires and tire pressure

    f. Cutting edges and end bits

NOTE: Locate each specific check and remember all warnings and cautions.

3. Starting procedures

    a. Locate the starting procedures in the technical manual or the operator's manual for the specific model grader.

    b. During the winter season, utilize the cold weather starting aids as described in the operator's manual.

4. Stopping procedures

    a. Locate the stopping procedures in the operator's manual or the user's manual for the specific model grader.

5. Operational Controls

    a. Check for proper steering.

    b. Check service brakes, slowly move the grader and check for proper operation.

6. Refueling the grader

    a. Set the parking brake.

    b. Place the grader in the proper park line position.

    c. Shut off the engine.

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d. Dismount the grader using three points of contact.

7. Weekly cleaning and service of the motor grader

a. Ensure the wash rack is scheduled.

b. Convoy graders to the wash rack.

c. Cleaning the interior:

d. On the park line, sweep out the cabs (operator compartment) and remove all dirt and trash.

e. Wash / wipe down all glass to remove water spots or smudges.

8. Lubricating the grader

a. Locate the lubrication chart listed in the technical manual or operator's manual for the specific model of grader.

b. Using a clean rag, wipe off each grease fitting prior to lubricating it.

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Chapter 5

Leveling Operations

1. Park line position

    a. The moldboard is pitched all the way forward.

    b. The toe of the moldboard is 3 to 4 feet behind the right front tire.

    c. The left lift cylinder (heel) is straight up and down.

    d. The moldboard is lightly touching the ground (no excessive down pressure).

    e. The scarifier teeth are lightly touching the ground (same as the blade).

2. Carry position; execute this maneuver from the park line position.

    a. Fully raise the scarifier log.

    b. Raise the moldboard off the surface approximately 6" to 8".

    c. Pitch the moldboard all the way to the rear (back).

    d. Center shift all the way to the left.

    e. Circle the moldboard counter-clockwise until the toe and heel are within parameters of the right front tire and the left front tandem tire (approximately 45 degrees).

NOTE: Pay particular attention while circling the moldboard so not to hit (damage) the scarifier or step.

    f. Raise the toe and heel of the moldboard. The toe cylinder is raised fully (closed) and the heel cylinder is raised until the moldboard is level.

3. Right hand general grade position; execute this maneuver from any position.

    a. Ensure the scarifier log is fully retracted (up).

    b. Ensure the height of the moldboard is within 6" to 8" from the surface (this will provide unrestricted movement and prevent metal to metal contact).

    c. Circle the moldboard clockwise to within 50 degrees to 60 degrees of the main frame (ensure the toe is on the right side of the grader).

    d. Ensure that the moldboard is pitched halfway.

    e. Center shift until the left lift (heel) cylinder is straight up and down.

    f. Lean the front wheels to the left.

NOTE: Always lean your front wheels to the direction of the heel cylinder.

    g. Lower the moldboard to the ground.

4. Left hand general grade position; execute this maneuver from any position.

    a. Ensure the scarifier log is fully retracted (up).

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b. Ensure the height of the moldboard to within 6" to 8" from the surface (this will provide unrestricted movement and prevent metal to metal contact).

c. Circle the moldboard clockwise to within 50 degrees to 60 degrees of the main frame (ensure the toe is on the left side of the grader).

d. Ensure that the moldboard is pitched halfway.

e. Center shift until the right lift (heel) cylinder is straight up and down.

f. Lean the front wheels to the right.

NOTE: Always lean your front wheels to the direction of the heel cylinder.

g. Lower the moldboard to the ground.

5. Center windrow position; execute this maneuver from any position.

a. Ensure the scarifier log is fully retracted (up).

b. Ensure the height of the moldboard to within 6" to 8" from the surface (this will provide unrestricted movement and prevent metal to metal contact).

c. Ensure that the moldboard is pitched halfway.

d. Circle the moldboard to 90 degrees to the frame (straight across).

e. Center shift until both lift cylinders are equally spaced to the main frame.

f. Lower the moldboard to half the height of the windrow to be spread (Example: Windrow is 6" high, lower the moldboard to within 3" to the surface).

6. Scarifying position; execute this maneuver from any position.

a. Ensure the scarifier log is fully retracted (up).

b. Ensure the moldboard is raised to within 6" to 8" from the surface.

c. Ensure that the moldboard is pitched halfway.

d. Circle the moldboard to 90 degrees to the frame (straight across).

e. Center shift until both lift cylinders are equally spaced to the main frame.

f. Raise the moldboard to approximately 12" off the surface.

g. Lower the scarifier log to the surface.

NOTE: It is unsafe to back the grader in the center windrow or scarifying position. The moldboard extends out past the tires of the grader creating a safety risk.

Never back the grader with the front wheels leaned. After completing each general grading position, always return the front wheels to the straight up and down position prior backing the grader back to the starting area.

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Chapter 5

Leveling Operations

7. Establishing the working area.

8. Site survey (visual overview).

9. Determine the boundaries (starting and finishing points).

    a. Scarifying

    b. Leveling

10. Scarify the work site.

    a. Position the grader outside the working area of the project.

    b. Place the grader in the scarifying position.

    c. Ensure the moldboard is raised to within 6" to 8" from the surface.

    d. Ensure that the moldboard is pitched halfway.

    e. Circle the moldboard to 90 degrees to the frame and adjust to approximately 12" off the surface and level.

    f. Center shift until both lift cylinders are equally spaced to the main frame.

    g. Ensure the front wheels are straight up and down.

    h. Place the grader in forward motion.

    i. Lower the scarifier log to the surface as it crosses the project starting point and penetrate the surface.

    j. Scarify the entire length of the area to a minimum depth of 6".

NOTE: The maximum penetrating depth of the scarifier is the length of the shank.

    k. Slowly raise the scarifier log after reaching the finish point.

    l. Exit the project area and stop the grader.

    m. Rotate the moldboard to a 50 degree angle and adjust the center shift to straighten the heel cylinder.

    n. Return to the starting point and reposition the grader for a second scarifying pass.

NOTE: Each student will complete three scarifying passes; each will overlap one scarifier tooth.

CAUTION: Never back the grader while in the scarifying position. The moldboard is a safety factor when the ends extend out past the width of the grader.

11. Leveling the area.

    a. Right to Left: Beginning at the right side of the area boundary, blade the material from the right side to the left side. Be certain to center the grader on the windrow for each consecutive pass leaving a windrow of material along the left boundary.

    b. Left to Right: The same procedure as right to left except that the starting point in on the left boundary line.

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c. Center to Right / Center to Left: Beginning at approximately the center line of the area, blade the material (level) from the center starting point to the left boundary line. Reposition the grader to the center line again, blade the material (level) from the center starting point to the right boundary line.

NOTE: Leveling an area is nothing more than cutting the highs and filling in the lows.

d. Position the grader outside the working area of the project approximately halfway or in the center of the width of the project area.

e. Ensure the moldboard to within 6" to 8" from the surface to allow unrestricted movement.

f. Rotate the moldboard so as the toe is on the right side of the grader and ensure the moldboard is at a 50 degree to 60 degree angle to the frame.

g. Ensure the moldboard is pitched halfway.

h. Center shift to the right or left until the heel cylinder is straight up and down.

i. Lean the wheel toward the heel of the blade.

j. Lower the moldboard until the toe and the heel is touching the ground (lightly).

k. Place the grader in a forward motion, and as the moldboard crosses the project start line apply enough down pressure on both the toe and the heel to penetrate the surface approximately 1/2" (level).

NOTE: While grading with the moldboard or using the scarifying log, use the hand throttle to control the RPMs of the grader. When the pass is complete, disengage the hand throttle and use the accelerator pedal while backing the grader back to the starting point of the project.

l. Maintaining a straight course, adjusting the moldboard slightly to carry the material the entire length of the project.

m. Be sure to feather the material out at the end of the pass.

NOTE: Feathering is a process that is accomplished by raising the moldboard in 1/2" to 1" increments, while in a forward motion. Two or three seconds are recommended between each upward adjustment until all the material in front of the moldboard passes under it.

n. After the material is feathered to a smooth termination, stop the grader and straighten the front wheels.

o. Raise both lift cylinders all the way up.

p. Position the grader so as to straddle the windrow just made, backup to the starting point, ensure the windrow is between the wheels and do not drive on top of it.

q. Stop the grader just outside the project boundary line.

NOTE: If your position at the far end of the project was executed correctly, as you face forward, you should be centered on the windrow and no additional adjustments are necessary.

12. Right hand or Left hand general grade:

a. Lean the wheels to the left and lower the toe and heel to the surface.

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b. Place the grader in a forward motion. As the moldboard crosses the starting line skim the surface that was cut on the previous pass with the toe of the moldboard. Increase the heel pressure downward to cut approximately 1/2" and carry the material the full length of the project area.

c. Again, feather the material at the end of the pass.

d. Stop the grader far enough forward that repositioning will not disturb the windrow.

e. Straighten the wheels and raise both lift cylinders all the way up.

f. Return to the center of the project start point and align the grader so as the toe overlaps no more than 12" of the first pass.

g. Position the grader in the left hand general grade position. Remember, skim the surface with the toe and apply enough down pressure on the heel to cut 1/2" and carry the material the full length of the project area

h. Complete two passes, following the same procedures discussed earlier.

NOTE: A slight windrow should be aligned both right and left boundaries of the project.

13. Crowning the Surface

a. Position the grader in right hand general grade position so the toe is aligned just inside the windrow or project boundary.

b. Lower the toe and heel level to the surface.

c. Raise the heel approximately 2". Adjust the toe if necessary to maintain contact with the surface.

d. Place the grader in a forward motion. As the toe of the moldboard crosses the project start point, apply enough down pressure to cut approximately 1/2".

NOTE: When applying up or down pressure on one lift cylinder (either the toe or the heel) the other end of the moldboard will slightly lower or rise. Therefore, adjustments are required to maintain the heel or toe to the desired setting.

e. Maintain a straight course along the inside boundary of the project.

f. Be sure to feather the material at the end of the pass.

g. Stop the grader; position the front wheels straight up and down.

h. Raise both lift cylinders all the way up and position the grader to straddle the windrow when backing up to the starting point.

i. Stop the grader outside the project working area.

j. Position the grader so as the toe (in the left hand general grade) is aligned just inside the windrow or project boundary (left side).

k. Follow the same procedures as done in the previous pass (right hand general grade) except that it will be accomplished in the left hand general grade.

l. The windrow created from this pass should be touching or close to the windrow made by the first pass.

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m. Again, feather the material at the end of the pass and be careful to straddle the windrow(s) as the grader is backing to the starting point.

NOTE: The final step in road construction with the motor grader is building the crown. This final pass is accomplished by cutting and spreading the windrow(s) that is (are) left by the two previous passes (right hand and or left hand general grades). The final pass is accomplished in the "center windrow position".

14. Finish the crowning of the Surface.

a. Looking forward at the project, the grader should be centered on the windrow(s).

b. Place the grader in the center windrow position.

c. Rotate the moldboard so as it is 90 degrees to the frame (straight across).

d. Center shift until both lift cylinders are centered on the grader.

e. Ensure the moldboard is pitched halfway.

NOTE: Do not lean the front wheels. The wheels will remain straight during the center windrow position.

f. Lower the moldboard to the surface. Determine the height of the windrow and raise it half the height of the windrow (Example: The windrow appears to be 6" high, raise the blade 3" off the ground).

g. Place the grader in a forward motion making only minor adjustments to the moldboard.

h. Continue to the end of the project or until all the material in front of the moldboard passes under it.

FINAL NOTE: Repeat any or all steps required to shape the lane / road to the desired specifications.

NOTES

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Chapter 6

Ditching Operations

1. Site preparation

    a. Identify the working area

    b. Conduct a visual overview (site survey).

    c. Determine the start and finish points.

    d. Prepare the site by leveling and/or scarifying if needed.

NOTE: Ditching is normally done on the right hand side of the grader as it has greater reach to this side.

    e. Position the moldboard high enough off the surface to allow unrestricted movement.

2. Marking Cut

    a. Pitch the blade forward halfway.

    b. Center the blade on the circle by side shifting if needed.

    c. Center shift until the heel cylinder is straight up and down.

    d. Rotate the moldboard so the toe is just behind the outside edge of the right front tire, approximately a 45 degree angle.

    e. Blade side shift, if necessary, to extend the moldboard edge to the outside edge of the right front tire.

    f. Raise the left heel lift cylinder all the way until it is closed.

    g. Lean the front wheels to the heel.

NOTE: The grader is now in the ditching position. Align the right front tire on top of the proposed ditch line. Make a visual check to the finish point of the ditch. Maintain control of the grader and do not permit it to deviate from the proposed ditch line.

    h. Place the grader in motion and as the right front tire passes over the starting point of the ditch, lower the toe of the moldboard by pushing the right lift cylinder control lever forward.

    i. Apply enough pressure on the toe to penetrate the surface 3 to 4".

NOTE: At this point, the primary concern is to follow the proposed ditch line (Example: If stakes are utilized, ensure the right front tire is directly in line with the next stake).

    j. At the completion of the marking cut, feather the material and raise the toe all the way. Continue the forward until the rear tires pass through the marking cut.

    k. Straighten the front wheels and steer the grader toward the toe side and approximately 45 degree to the ditch.

    l. Back the grader along the outside edge of the windrow.

    m. Reposition the grader at the starting point.

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Chapter 6

Ditching Operations

NOTE: At this point, stop the grader just as the right front tire enters into the marking cut.

3. Ditching cut

    a. Place the grader in forward motion and apply as much down pressure to the toe of the blade as the grader will handle, not to exceed 4".

NOTE: Attempting to cut more then 4" will result in the grader stalling or pulling to one side. Lift slightly on the toe in the event that either should happen (DO NOT ATTEMPT TO STEER OUT OF THE PULL).

    b. Continue along the ditch line until the grader has reached the finishing point. Then follow the exit procedures discussed earlier (step 2 e, f, and g).

    c. If the depth of 12" was not achieved, reposition the grader to the starting point and make additional cuts.

    d. If the depth of 12" was achieved, reposition the grader to the starting point. However, do not place the right front tire into the center or directly on top of the ditch.

    e. Position the grader so the right front tire is approximately 12" to 15" to the left of the ditch centerline and stop the grader.

4. Construct the Shoulder of the Ditch

NOTE: This task is accomplished by placing the grader in the wide side reach position.

    a. Rotate the moldboard to 0 degrees and adjust the height of the blade to approximately 4" to 6" off the surface.

CAUTION: This will prevent damage to the saddle and circle on some graders.

    b. Center shift all the way to the right.

    c. Readjust the height of the blade to approximately 2" off the surface (This is the most commonly missed step).

    d. Blade side shift all the way to the right.

    e. Lean the front wheels to the left (soon to be the heel).

    f. Circle the moldboard counterclockwise until the toe is approximately 12" to 15" from the outside edge of the right front tire (Approximately a 45 degree angle).

NOTE: Do not adjust the moldboard height, especially the heel or left lift cylinder. The view is somewhat obscured because the heel is under the main frame of the grader.

    g. Place the grader in forward motion and maintain a position and course so the toe of the moldboard passes directly over the center of the ditch.

    h. Apply enough down pressure to skim the material from the shoulder. Do not cut the shoulder.

    i. As the grader passes the finishing point of the ditch, continue forward until all the material in front of the moldboard passes under it or is windrowed off the heel. It may be necessary to feather the material.

    j. Continue forward until enough space is available to position the grader to back up and straddle the windrow. (It is not necessary to pull off to a 45 degree angle as the windrow is already down the center of the mainframe.

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k. Stop the grader and place the moldboard only in the right hand general grade position.

l. Ensure the front wheels are straight up and down prior to backing the grader.

m. Back the grader to the starting point by straddling the windrow.

NOTE: Do not back the grader in the wide side reach position. Again, a safety factor is apparent; the moldboard would be extended out past the tires of the grader. By placing the moldboard in the right hand general grade position, the safety factor is minimized and the moldboard is positioned to execute the next maneuver.

5. Right hand General Grade Modified.

NOTE: The final step in road construction with the motorized grader is building the crown. This final pass is accomplished by cutting and spreading the material left by cutting the ditch in a manner that there is a raised portion of the road. This raised crown will allow precipitation to flow off and away from the roadway.

a. Stop the grader outside the starting point of the project and lean the wheels to the left.

b. Adjust the heel approximately 2” to 3" and ensure that toe is just touching the surface.

c. Place the grader in forward motion and maintain a straight course by keeping the grader centered on the windrow.

d. Skim the shoulder of the road with the toe and spread the windrow to form the surface of the road.

NOTE: With the heel raised approximately 2 to 3", the loose material from the ditch should pass under and off the heel of the moldboard, thereby establishing the crown of the road.

e. At the end of the pass, ensure the material is feathered prior to stopping the grader.

f. Straighten the front wheels and raise both left cylinders all the way.

g. Reposition the grader at the finishing end of the project. The grader should be positioned to establish a V-ditch on the other side of the project area going the opposite direction.

NOTE: At this point, park the grader and switch operators. The next operator will establish the ditch on the other side of the road using the same procedures just discussed. After both ditches have been established and the material is graded into a center windrow, the second operator will complete the final pass to spread the windrow.

6. Center windrow Position. Position the grader in the center windrow position and half the height of the windrow and spread it evenly across the road surface to finish the crown.

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Appendix A

Student Performance Evaluation Sheets

PRACTICAL EXERCISE SHEET PE1

Evaluation Guidance: Score the Soldier GO if all steps are passed (P). Score the Soldier NO-GO if any step is failed (F). If the Soldier fails any step, retrain and retest them. Retraining will be conducted outside of the training day.

PERFORMANCE MEASURES	DATE	GO	1st NO GO	2nd NO GO	Points
PRE-OPERATION PROCEDURES					
Did the student:					
1. Perform a 360 degree walk around of equipment.	_____	____	_____	_____	_____
2. Perform before operations PMCS.	_____	____	_____	_____	_____
3. Perform pre-start procedures.	_____	____	_____	_____	_____
4. Perform starting procedures.	_____	____	_____	_____	_____
5. Configure Grader to travel position.	_____	____	_____	_____	_____
6. Perform all measures safely.	_____	____	_____	_____	_____
AFTER OPERATION PROCEDURES					
Did the student:					
1. Configure Grader to park line position.	_____	____	_____	_____	_____
2. Perform stopping procedures.	_____	____	_____	_____	_____
3. Perform after operations PMCS.	_____	____	_____	_____	_____
4. Perform all measures safely.	_____	____	_____	_____	_____

Evaluator's Comments:

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_____

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Evaluator's Signature:_____

Evaluator's Signature:_____

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Appendix A

Student Performance Evaluation Sheets

PRACTICAL EXERCISE SHEET PE1

Evaluation Guidance: Score the Soldier GO if all steps are passed (P). Score the Soldier NO-GO if any step is failed (F). If the Soldier fails any step, retrain and retest them. Retraining will be conducted outside of the training day.

PERFORMANCE MEASURES	DATE	GO	1st NO GO	2nd NO GO	Points
LEVELING OPERATIONS					
Did the student:					
1. Perform pre-operation procedures.	_____	____	_____	_____	_____
2. Configure the grader to right hand general grade position	_____	____	_____	_____	_____
3. Level the road/lane from right to left.	_____	____	_____	_____	_____
4. Perform after operation procedures.	_____	____	_____	_____	_____
5. Perform all measures safely.	_____	____	_____	_____	_____

Evaluator's Comments:

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Evaluator's Signature:_____

Evaluator's Signature:_____

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Appendix A

Student Performance Evaluation Sheets

PRACTICAL EXERCISE SHEET PE1

Evaluation Guidance: Score the Soldier GO if all steps are passed (P). Score the Soldier NO-GO if any step is failed (F). If the Soldier fails any step, retrain and retest them. Retraining will be conducted outside of the training day.

PERFORMANCE MEASURES	DATE	GO	1st NO GO	2nd NO GO	Points
V - DITCHING OPERATIONS					
Did the student:					
1. Perform pre-operation procedures.	_____	____	_____	_____	_____
2. Configure the grader to ditching position	_____	____	_____	_____	_____
3. Constructs a marking cut 2-3” deep.	_____	____	_____	_____	_____
4. Constructs a ditching cut no more than 4” deep.	_____	____	_____	_____	_____
5. Configure the grader to wide side reach position and construct the shoulder.	_____	____	_____	_____	_____
5. Perform a leveling pass.	_____	____	_____	_____	_____
5. Perform after operation procedures.	_____	____	_____	_____	_____
5. Perform all measures safely.	_____	____	_____	_____	_____

Evaluator’s Comments:

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Evaluator's Signature: _____

Evaluator's Signature: _____